

DOCUMENT-IDENTIFIER: US 6046072 A

TITLE: Process for fabricating a crack resistant resin encapsulated semiconductor chip package

----- KWIC -----

ASZZ:

Hitachi Chemical Company, Ltd.

ABPL:

A heat-resistant adhesive is provided for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and sealing at least the semiconductor chip and a bonded part between the semiconductor chip and the lead frame with a sealant. The adhesive has a coming-out length of not more than 2 mm and a water absorption rate of not more than 3 wt. %. Preferably, the adhesive has a glass transition point of at least 200.degree. C.

BSPR:

(a) a heat-resistant adhesive suitable for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and molding at least the semiconductor chip and the bonded part between the semiconductor chip and the lead frame with a molding compound, in which the heat resistant adhesive has a coming-out-length of not more than 2 mm and a water absorption rate of not more than 3 wt. %,

BSPR:

(b) a heat-resistant adhesive suitable for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and molding at least

the semiconductor chip and the bonded part between the semiconductor chip and the lead frame with a molding compound, in which the heat-resistant adhesive has a coming-out length of not more than 2 mm, a water absorption rate of not more than 3 wt. % and a glass transition temperature of at least 200.degree. C.,

BSPR:

The term "water absorption rate" used herein means a water absorption rate obtained from a change in weight of an adhesive before and after immersion in water. Here, a film of the adhesive having a size of 5 cm.times.5 cm with a thickness of 25 .mu.m is used as a testing object and, after dried at 100.degree. C. for 1 hour, it is immersed in water at 23.degree. C. for 24 hours to measure the water absorption.

DEPR:

No particular limitation is imposed on the specific heat-resistant adhesive employed in the present invention insofar as its water absorption rate and coming-out length are not more than 3 wt. % and not more than 2 mm. Among preferred heat-resistant adhesives are those with a principal constituent of thermoplastic resin, preferably having a glass transition temperature of at least 200.degree. C. For these reasons, a polyimide adhesive or a polyamide adhesive is preferred.

DEPR:

The water absorption rate of the heat-resistant adhesive according to the present invention is 3 wt. % or less, preferably 2.5 wt. % or less, more preferably 2.0 wt. % or less. Its coming-out length is 2 mm or less, preferably 1 mm or less, more preferably 0.5 mm or less. In particular, the heat-resistant adhesive according to the present invention desirably has, in

addition to the properties described above, a glass transition temperature of at least 200.degree. C., preferably 225.degree. C. or higher, more preferably 250.degree. C. or higher.

DEPR:

Where the glass transition temperature is lower than 250.degree. C. or the coming-out length is greater than 1 mm in the present invention, the water

absorption rate is preferably not more than 3 wt. %, in particular, 1.5 wt. %.

The thinner the sealing material is or the higher the percentage of the occupation of the adhesive in a package is, the more preferable it is to have a shorter coming-out length.

DEPR:

Amide groups may mount to 10-90 mole %, preferably 20-70 mole %, more preferably 30-50 mole % of the sum of imide groups and amide groups.

Percentages smaller than 10 mole % lead to small adhesion but percentages greater than 90 mole % result in a large water absorption rate.

DEPR:

The heat-resistant adhesive according to the present invention can be

synthesized principally from (A) a diamine or (A') a diisocyanate and (B) an acid anhydride and/or (C) a dicarboxylic acid or an amide-forming derivative

thereof. The heat-resistant adhesive can be easily produced by combining the above reactants and also adjusting their reaction ratio, reaction conditions and molecular weight, optionally adding additives while selecting their types and optionally adding an additional resin such as an epoxy resin in such a way that the resulting heat-resistant adhesive has the prescribed properties described above, namely, a coming-out length of not more than 2 mm a water

absorption rate of not more than 3 wt. % and preferably a glass transition temperature of at least 200.degree. C.

DEPR:

In this case, it has been found that even if a heat-resistant adhesive has Tg lower than 200.degree. C., mixing of an additional resin such as an epoxy resin and one or more of the below-described additives, such as a coupling agent, make it possible to adjust its water absorption rate and coming-out length within the respective ranges specified in the present invention.

DEPR:

No particular limitation is imposed on the epoxy resin which can be mixed with a specific heat-resistant polyimide adhesive of the present invention, in so far as it has at least 2 epoxy groups on average per molecule. Examples of such an epoxy resin include the glycidyl ether of bisphenol A, the glycidyl ether of bisphenol F, phenolnovolak type epoxy resins, polyglycidyl esters of polyhydric alcohols, polyglycidyl esters of polybasic acids, alicyclic epoxy resins and hydantoin epoxy resins.

DEPR:

When the heat-resistant adhesive according to the present invention is used as a composite adhesive sheet by coating it on a base film (or sheet), the composite adhesive sheet can be obtained by coating a heat-resistant adhesive having a water absorption rate of not more than 3 wt. % and a coming-out length of not more than 2 mm and, preferably, a glass transition temperature of at least 200.degree. C. or a varnish thereof on both surfaces of a heat-resistant film, preferably a surface-treated heat-resistant film.

DEPR:

The heat-resistant film has a glass transition temperature

(Tg) which is higher than that (Tg) of the heat-resistant adhesive according to the present invention and is preferably at least 200.degree. C., more preferably 250.degree. C. or higher. The heat-resistant film has a water absorption rate of not more than 3 wt. %, preferably 2 wt. % or lower.

DEPR:

Accordingly, the heat-resistant film employed in this invention may preferably be a polyimide film in view of Tg, water absorption rate and coefficient of thermal expansion. Particularly preferred is a film equipped with the physical properties that the Tg is at least 250.degree. C., the water absorption rate is 2 wt. % or less and a coefficient of thermal expansion of 3.times.10.⁻⁵ /.degree. C. or lower.

DEPR:

The film was immersed in water of 25.degree. C. for 24 hours. As a result, it was found to have a water absorption rate of 0.3 wt. %.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 1.21 dl/g, Tg of 268.degree. C., a thermal decomposition point of 410.degree. C., a water absorption rate of 0.7 wt. % and a coming-out length of 0.01 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.48 dl/g, Tg of 300.degree. C., a thermal decomposition temperature of 405.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 0.5 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.61 dl/g, Tg of 275.degree. C., a thermal decomposition temperature of 415.degree. C.,

a water absorption rate of 0.5 wt. % and a coming-out length of 1.5 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.62 dl/g, Tg of 255.degree. C., a thermal decomposition temperature of 440.degree. C., and a water absorption rate of 1.2 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyamide so obtained was found to have a reduced viscosity of 0.45 dl/g, Tg of 219.degree. C., a thermal decomposition temperature of 425.degree. C., a water absorption rate of 2.3 wt. % and a coming-out length of 2.4 mm.

DEPR:

The composite film was found to have Tg of 255.degree. C., a water absorption rate of 0.6 wt. % and a coming-out length of 1.5 mm.

DEPR:

In 20 g of DMF, 1.74 g (7 mmole) g of 4,4'-diaminodiphenylsulfone (DDS) and 1.23 g (3 mmole) of BAPP were dissolved, followed by the addition of 2.02 g (20 mmole) of triethylamine. While being cooled below 5.degree. C., the resulting solution was added with 2.03 g (10 mmole) of isophthaloyl chloride in portions. They were reacted for 5 hours below 5.degree. C. As in Example 1, a polyamide was obtained in the form of powder. The polyamide so obtained was found to have a reduced viscosity of 0.88 dl/g, Tg of 260.degree. C., a thermal decomposition temperature of 435.degree. C., a water absorption rate of 2.5 wt. % and a coming-out length of 0.2 mm.

DEPR:

The composite film was found to have Tg of 260.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 0.5 mm.

DEPR:

The polyamide-imide so obtained was found to have a reduced viscosity of 1.15 dl/g, Tg of 258.degree. C., a thermal decomposition temperature of 385.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 0.02 mm.

DEPR:

In a similar manner to Example 1 except that 5.76 g (10 mmole) of BABT, 2.74 g (7.5 mmole) of IPDDM, 0.41 g (1.0 mmole) of BAPP and 1.26 g (1.5 mmole) of "X-22-161AS" were used instead, a polyimide was obtained in the form of powder. The polyimide so obtained was found to have a reduced viscosity of 0.65 dl/g, Tg of 226.degree. C., a thermal decomposition temperature of 396.degree. C., a water absorption rate of 0.3 wt. % and a coming-out length of 1.7 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.87 dl/g, Tg of 270.degree. C., a thermal decomposition temperature of 520.degree. C., a water absorption rate of 2.3 wt. % and a coming-out length of 0.01 mm.

DEPR:

The polyamide-imide so obtained was found to have a reduced viscosity of 0.57 dl/g, Tg of 185.degree. C., a thermal decomposition temperature of 420.degree. C., a water absorption rate of 0.13 wt. % and a coming-out length of 0.8 mm.

DEPR:

A varnish which had been obtained by dissolving 100 g of the polyamide-imide powder and 3 g of .gamma.-glycidoxypropyltrimethoxysilane in 400 g of DMF was coated on one surface of a polyimide film ("UPILEX S", trade name), followed by drying at 100.degree. C. for 10 minutes. The other surface of the polyimide film was also coated with the varnish similarly, followed

by drying at 250.degree. C. for 10 minutes, whereby a composite sheet was obtained. The composite sheet so obtained was found to have an adhesive strength of 1.6 kN/m with a 42 alloy sheet. The adhesive layers were found to have Tg of 185.degree. C., a water absorption rate of 1.3 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.65 dl/g, Tg of 170.degree. C., a thermal decomposition temperature of 390.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 1.8 mm.

DEPR:

Using a varnish obtained by dissolving 100 g of the polyimide powder and 5 g of .gamma.-glycidoxypropyl-methyldiethoxysilane in 400 g of DMF, a composite sheet was obtained as in Example 13. The composite sheet had an adhesive strength of 1.3 kN/m with a 42 alloy sheet. In addition, the adhesive layers were found to have Tg of 172.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 1.8 mm.

DEPR:

The polyamide-imide so obtained was found to have a reduced viscosity of 0.85 dl/g, Tg of 190.degree. C., a thermal decomposition temperature of 395.degree. C., a water absorption rate of 0.1 wt. % and a coming-out length of 0.6 mm.

DEPR:

A varnish obtained by dissolving 100 g of the polyamide-imide powder and 10 g of .gamma.-glycidoxypropyl-methyldiethoxysilane in 400 g of NMP was coated on both surfaces of a polyimide film ("UPILEX S", trade name). The varnish so coated was dried at 100.degree. C. for 10 minutes and then

at 275.degree. C. for 10 minutes, whereby a composite sheet was obtained. The composite sheet was found to have an adhesive strength of 1.4 kN/m with a 42 alloy sheet. In addition, the adhesive layers were found to have Tg of 191.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyamide so obtained was found to have a reduced viscosity of 0.45 dl/g, Tg of 280.degree. C., a thermal decomposition temperature of 430.degree. C., a water absorption rate of 3.5 wt. % and a coming-out length of 1.2 mm.

DEPR:

In a similar manner to Example 4, polyimide powder having a reduced viscosity of 0.35 dl/g was obtained. The polyimide so obtained was found to have Tg of 275.degree. C., a thermal decomposition temperature of 410.degree. C., a water absorption rate of 0.6 wt. % and a coming-out length of 3.4 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.44 dl/g, Tg of 187.degree. C., a thermal decomposition temperature of 465.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 2.2 mm.

CLPR:

14. A method of selecting an adhesive for fabrication of a semiconductor package by bonding a semiconductor chip to lead frames, comprising measuring the coming-out length of an adhesive and a step of selecting an adhesive whose coming-out length is not longer than 2 mm and whose water absorption rate is not higher than 3% by weight,

CLPV:

said adhesive member is made of polyimide or polyamide and includes a heat-resistant adhesive having a coming-out length of not more than 2 mm and a water absorption rate of not more than 3 wt %,

CLPV:

wherein said water absorption rate is measured by steps of:

CLPW:

calculating the water absorption rate of the adhesive from the weight difference of the film before and after being soaked in water.

DOCUMENT-IDENTIFIER: US 6248613 B1

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ABPL:

A heat-resistant adhesive is provided for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and sealing at least the semiconductor chip and a bonded part between the semiconductor chip and the lead frame with a sealant. The adhesive has a coming-out length of not more than 2 mm and a water absorption rate of not more than 3 wt. %. Preferably, the adhesive has a glass transition point of at least 200.degree. C.

BSPR:

The term "water absorption rate" used herein means a water absorption rate obtained from a change in weight of an adhesive before and after immersion in water. Here, a film of the adhesive having a size of 5 cm.times.5 cm with a thickness of 25 .mu.m is used as a testing object and, after dried at 100.degree. C. for 1 hour, it is immersed in water at 23.degree. C. for 24 hours to measure the water absorption.

BSPV:

(a) a heat-resistant adhesive suitable for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and molding at least the semiconductor chip

and the bonded part between the semiconductor chip and the lead frame with a molding compound, in which the heat-resistant adhesive has a coming-out-length of not more than 2 mm and a water absorption rate of not more than 3 wt. %,

BSPV:

(b) a heat-resistant adhesive suitable for use in an adhesive member for the fabrication of a semiconductor package by bonding a semiconductor chip to a lead frame with the adhesive member and molding at least the semiconductor chip and the bonded part between the semiconductor chip and the lead frame with a molding compound, in which the heat-resistant adhesive has a coming-out length of not more than 2 mm, a water absorption rate of not more than 3 wt. % and a glass transition temperature of at least 200.degree. C.,

DEPR:

No particular limitation is imposed on the specific heat-resistant adhesive employed in the present invention insofar as its water absorption rate and coming-out length are not more than 3 wt. % and not more than 2 mm. Among preferred heat-resistant adhesives are those with a principal constituent of a heat-resistant thermoplastic resin, preferably having a glass transition temperature of at least 200.degree. C. For these reasons, a polyimide adhesive or a polyamide adhesive is preferred.

DEPR:

The water absorption rate of the heat-resistant adhesive according to the present invention is 3 wt. % or less, preferably 2.5 wt. % or less, more preferably 2.0 wt. % or less. Its coming-out length is 2 mm or less, preferably 1 mm or less, more preferably 0.5 mm or less. In particular, the heat-resistant adhesive according to the present invention desirably has, in

addition to the properties described above, a glass transition temperature of east 200.degree. C., preferably 225.degree. C. or higher, more preferably 250.degree. C. or higher.

DEPR:

Where the glass transition temperature is lower than 250.degree. C. or the coming-out length is greater than 1 mm in the present invention, the water absorption rate is preferably not more than 3 wt. %, in particular, 1.5 wt. %. The thinner the sealing material is or the higher the percentage of the occupation of the adhesive in a package is, the more preferable it is to have a shorter coming-out length.

DEPR:

Amide groups may mount to 10-90 mole %, preferably 20-70 mole %, more preferably 30-50 mole % of the sum of imide groups and amide groups. Percentages smaller than 10 mole % lead to small adhesion but percentages greater than 90 mole % result in a large water absorption rate.

DEPR:

The heat-resistant adhesive according to the present invention can be synthesized principally from (A) a diamine or (A') a diisocyanate and (B) an acid anhydride and/or (C) a dicarboxylic acid or an amide-forming derivative thereof. The heat-resistant adhesive can be easily produced by combining the above reactants and also adjusting their reaction ratio, reaction conditions and molecular weight, optionally adding additives while selecting their types and optionally adding an additional resin such as an epoxy resin in such a way that the resulting heat-resistant adhesive has the prescribed properties described above, namely, a coming-out length of not more than 2 mm a water

absorption rate of not more than 3 wt. % and preferably a glass transition temperature of at least 200.degree. C.

DEPR:

In this case, it has been found that even if a heat-resistant adhesive has Tg lower than 200.degree. C., mixing of an additional resin such as an epoxy resin and one or more of the below-described additives, such as a coupling agent, make it possible to adjust its water absorption rate and coming-out length within the respective ranges specified in the present invention.

DEPR:

No particular limitation is imposed on the epoxy resin which can be mixed with a specific heat-resistant polyimide adhesive of the present invention, in so far as it has at least 2 epoxy groups on average per molecule. Examples of such an epoxy resin include the glycidyl ether of bisphenol A, the glycidyl ether of bisphenol F, phenolnovolak type epoxy resins, polyglycidyl esters of polyhydric alcohols, polyglycidyl esters of polybasic acids, alicyclic epoxy resins and hydantoin epoxy resins.

DEPR:

When the heat-resistant adhesive according to the present invention is used as a composite adhesive sheet by coating it on a base film (or sheet), the composite adhesive sheet can be obtained by coating a heat-resistant adhesive having a water absorption rate of not more than 3 wt. % and a coming-out length of not more than 2 mm and, preferably, a glass transition temperature of at least 200.degree. C. or a varnish thereof on both surfaces of a heat-resistant film, preferably a surface-treated heat-resistant film.

DEPR:

The heat-resistant film has a glass transition temperature

(Tg) which is higher than that (Tg) of the heat-resistant adhesive according to the present invention and is preferably at least 200.degree. C., more preferably 250.degree. C. or higher. The heat-resistant film has a water absorption rate of not more than 3 wt. %, preferably 2 wt. % or lower.

DEPR:

Accordingly, the heat-resistant film employed in this invention may preferably be a polyimide film in view of Tg, water absorption rate and coefficient of thermal expansion. Particularly preferred is a film equipped with the physical properties that the Tg is at least 250.degree. C., the water absorption rate is 2 wt. % or less and a coefficient of thermal expansion of 3.times.10.sup.-5 /.degree. C. or lower.

DEPR:

The film was immersed in water of 25.degree. C. for 24 hours. As a result, it was found to have a water absorption rate of 0.3 wt. %.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 1.21 dl/g, Tg of 268.degree. C., a thermal decomposition point of 410.degree. C., a water absorption rate of 0.7 wt. % and a coming-out length of 0.01 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.48 dl/g, Tg of 300.degree. C., a thermal decomposition temperature of 405.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 0.5 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.61 dl/g, Tg of 275.degree. C., a thermal decomposition temperature of 415.degree. C.,

a water absorption rate of 0.5 wt. % and a coming-out length of 1.5 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.62 dug, Tg of 255.degree. C., a thermal decomposition temperature of 440.degree. C., and a water absorption rate of 1.2 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyamide so obtained was found to have a reduced viscosity of 0.45 dl/g, Tg of 219.degree. C., a thermal decomposition temperature of 425.degree. C., a water absorption rate of 2.3 wt. % and a coming-out length of 2.4 mm.

DEPR:

The composite film was found to have Tg of 255.degree. C., a water absorption rate of 0.6 wt. % and a coming-out length of 1.5 mm.

DEPR:

In 20 g of DMF, 1.74 g (7 mmole) g of 4,4'-diaminodiphenylsulfone (DDS) and 1.23 g (3 mmole) of BAPP were dissolved, followed by the addition of 2.02 g (20 mmole) of triethylamine. While being cooled below 5.degree. C., the resulting solution was added with 2.03 g (10 mmole) of isophthaloyl chloride in portions.

They were reacted for 5 hours below 5.degree. C. As in Example 1, a polyamide was obtained in the form of powder. The polyamide so obtained was found to have a reduced viscosity of 0.88 dl/g, Tg of 260.degree. C., a thermal decomposition temperature of 435.degree. C., a water absorption rate of 2.5 wt. % and a coming-out length of 0.2 mm.

DEPR:

The composite film was found to have Tg of 260.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 0.5 mm.

DEPR:

The polyamide-imide so obtained was found to have a reduced viscosity of 1.15 dl/g, Tg of 258.degree. C., a thermal decomposition temperature of 385.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 0.02 mm.

DEPR:

In a similar manner to Example 1 except that 5.76 g (10 mmole) of BABT, 2.74 g (7.5 mmole) of IPDDM, 0.41 g (1.0 mmole) of BAPP and 1.26 g (1.5 mmole) of "X-22-161AS" were used instead, a polyimide was obtained in the form of powder. The polyimide so obtained was found to have a reduced viscosity of 0.65 dl/g, Tg of 226.degree. C., a thermal decomposition temperature of 396.degree. C., a water absorption rate of 0.3 wt. % and a coming-out length of 1.7 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.87 dl/g, Tg of 270.degree. C., a thermal decomposition temperature of 520.degree. C., a water absorption rate of 2.3 wt. % and a coming-out length of 0.01 mm.

DEPR:

The polyamide-imide so obtained was found to have a reduced viscosity of 0.57 dl/g, Tg of 185.degree. C., a thermal decomposition temperature of 420.degree. C., a water absorption rate of 0.13 wt. % and a coming-out length of 0.8 mm.

DEPR:

A varnish which had been obtained by dissolving 100 g of the polyamide-imide powder and 3 g of .gamma.-glycidoxypropyltrimethoxysilane in 400 g of DMF was coated on one surface of a polyimide film ("UPILEX S", trade name), followed by drying at 100.degree. C. for 10 minutes. The other surface of the polyimide film was also coated with the varnish similarly, followed

by drying at 250.degree. C. for 10 minutes, whereby a composite sheet was obtained. The composite sheet so obtained was found to have an adhesive strength of 1.6 kN/m with a 42 alloy sheet. The adhesive layers were found to have Tg of 185.degree. C., a water absorption rate of 1.3 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.65 dl/g, Tg of 170.degree. C., a thermal decomposition temperature of 390.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 1.8 mm.

DEPR:

Using a varnish obtained by dissolving 100 g of the polyimide powder and 5 g of .gamma.-glycidoxypropyl-methyldiethoxysilane in 400 g of DMF, a composite sheet was obtained as in Example 13. The composite sheet had an adhesive strength of 1.3 kN/m with a 42 alloy sheet. In addition, the adhesive layers were found to have Tg of 172.degree. C., a water absorption rate of 1.0 wt. % and a coming-out length of 1.8 mm.

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The polyamide-imide so obtained was found to have a reduced viscosity of 0.85 dl/g, Tg of 190.degree. C., a thermal decomposition temperature of 395.degree. C., a water absorption rate of 0.1 wt. % and a coming-out length of 0.6 mm.

DEPR:

A varnish obtained by dissolving 100 g of the polyamide-imide powder and 10 g of .gamma.-glycidoxypropyl-methyldiethoxysilane in 400 g of NMP was coated on both surfaces of a polyimide film ("UPILEX S", trade name). The varnish so coated was dried at 100.degree. C. for 10 minutes and then

at 275.degree. C. for 10 minutes, whereby a composite sheet was obtained. The composite sheet was found to have an adhesive strength of 1.4 kN/m with a 42 alloy sheet. In addition, the adhesive layers were found to have Tg of 191.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 0.2 mm.

DEPR:

The polyamide so obtained was found to have a reduced viscosity of 0.45 dl/g, Tg of 280.degree. C., a thermal decomposition temperature of 430.degree. C., a water absorption rate of 3.5 wt. % and a coming-out length of 1.2 mm.

DEPR:

In a similar manner to Example 4, polyimide powder having a reduced viscosity of 0.35 dl/g was obtained. The polyimide so obtained was found to have Tg of 275.degree. C., a thermal decomposition temperature of 410.degree. C., a water absorption rate of 0.6 wt. % and a coming-out length of 3.4 mm.

DEPR:

The polyimide so obtained was found to have a reduced viscosity of 0.44 dl/g, Tg of 187.degree. C., a thermal decomposition temperature of 465.degree. C., a water absorption rate of 1.1 wt. % and a coming-out length of 2.2 mm.

CLPW:

said adhesive member is made of polyimide or polyamide and includes a heat-resistant adhesive having a coming-out length of not more than 2 mm and a water absorption rate of not more than 3 wt. % wherein

DOCUMENT-IDENTIFIER: US 5319005 A

TITLE: Epoxy resin molding material for sealing of electronic component

----- KWIC -----

ASZZ:

Hitachi Chemical Co., Ltd.

BSPR:

As to the component (A) to be used in the present invention, namely the epoxy resin having at least two epoxy groups per molecule, any one used generally in known epoxy resin molding materials for sealing of electronic components can be used. Typical examples are epoxidation products of novolak resins of phenols and aldehydes, such as phenol novolak epoxy resin and o-cresol novolak epoxy resin; diglycidyl ether epoxy resins which are obtainable from the reaction of phenols, such as bisphenol A, bisphenol F, bisphenol S and alkyl-substituted biphenol, and epichlorohydrin; glycidylamine epoxy resins which are obtainable from the reaction of polyamines, such as diaminodiphenylmethane and isocyanuric acid, and epichlorohydrin; linear aliphatic epoxy resins and alicyclic epoxy resins which are obtainable by oxidation of olefinic bonds with peracids, such as peracetic acid; and brominated epoxy resins thereof.

BSPR:

Among various kinds of epoxy resins which may be used, a biphenyl structure epoxy resin represented by the following structural formula ##STR1## has a particularly excellent soldering resistance, and it is desirable that the epoxy resin in the epoxy resin molding material of the present invention contains at least 60% by weight of the biphenyl structure epoxy resin based on total of the

epoxy resin used. By the use of the epoxy resin containing 60% by weight or more of the biphenyl structure epoxy resin, the low water absorption and the adhesive properties of the molding material of the present invention is highly improved, thereby providing very high soldering resistance.

This biphenyl structure epoxy resin can be obtained by the epoxidation of 4,4'-dihydroxy-3,3',5,5'-tetramethylbiphenyl with epichlorohydrin.

BSPR:

Among various kinds of the phenolic compounds which may be used as the component (B), a phenol resin represented by the following structural formula

##STR2## has a particularly excellent soldering resistance, and it is

preferable that the phenolic compound in the epoxy resin molding material of

the present invention contains at least 60% by weight of the phenol resin based

on total of the phenolic compound used. By the use of the phenolic compound

containing 60% by weight or more of the phenol resin, the low water absorption

and the adhesive properties of the molding material of the present invention is

highly improved, thereby providing high soldering resistance. Using the

above-described biphenyl structure epoxy resin and this phenol resin in

combination further improves the soldering resistance of the epoxy resin

molding material of the present invention.

BSPR:

The epoxy resin molding material for sealing of electronic components of the present invention further contains an inorganic filler as a component (D).

Typical examples of the inorganic filler are crushed or spherical (beaded)

powder of fused silica, crystalline silica, alumina,

zircon, calcium silicate,

calcium carbonate, silicon carbide, silicon nitride,

beryllia, zirconia; single

crystal fiber of potassium titanate, silicon carbide, silicon nitride, alumina; and glass fiber. These inorganic fillers may be used individually or in combination of two or more of them. In order to decrease the water absorption and coefficient of thermal expansion and to increase the strength, the amount of the inorganic fillers added is preferably at least 70% by volume, more preferably from 70 to 80% by volume of the total of the epoxy resin molding material. Among the inorganic fillers described above, the preferred are fused silica from the viewpoint of decreasing the coefficient of thermal expansion, and alumina from the view point of high thermal conductivity. The shape of the inorganic fillers is preferably spherical for purposes of increasing the flowability of the molding materials and of preventing the abrasion of the molds during molding.

DETL:

TABLE 2

Example Nos.	Comparative	Example Nos.	Properties of
molding material		1 2 3 4	
5	1	2	3
1	3	4	5

Spiral flow (in)	30	52	33	35	33	35	41	34	35	38	Appearance
of molded product	good	good	good	good	good	good	bad	clouded	clouded	Critical surface	
tension (mN/m)	30	30	30	30	30	32	32	26	27	27	Marking
strength (the number of											
times)	>30	>30	>30	>30	>30	>30	>30	5	17	20	Adhering
strength (N/m)	Room										
temperature	420	630	690	850	860	400	840	520	380	750	
215.degree. C.	150	100									
140	160	160	150	170	110	130	130				<u>Water absorption</u> (wt. %)
24 hours	0.15	0.11									
0.08	0.07	0.07	0.12	0.06	0.07	0.15	0.07	72 hours	0.21		
0.18	0.14	0.11									
0.11	0.18	0.10	0.12	0.21	0.12	Thermal	shock	resistance			
>2000	>2000										
>2000	>2000	>2000	1200	1800	>2000	>2000	>2000				

(50%-crack-occurring cycles) Soldering resistance (h) 72 96 120 168 168 72 168 72 72 168
(humidifying time taken to cause crack) Moisture resistance (h) >1000 >1000 >1000 >1000 >1000 >1000 (time taken to cause 50%-failure)

DETL:

TABLE 3-2

85.degree. C. Percentage of weight change of Water absorption JIS-K-6911
Analytical balance 85% RH molded products (.phi.50 .times. t3)

Marking strength IC: standard DIP 16 pins (Marking was done on a mirror finished surface.) Marking: thermosetting ink *, 150.degree. C., one hour curing Evaluation: The number of times of rubbing with a cotton applicator until the mark which had been subjected to dipping in trichloroethylene for 10 minutes became blurred. Thermal shock resistance IC: flat package, 19 .times. 14 .times. 2.7 (mm), 54 pins, alloy 42 lead frame, chip 6 .times. 6 .times. 0.4 (mm) (cracking of IC packages) Molding: 180.degree. C., 70 kg/cm.sup.2, 90 sec + 180.degree. C., 5 hours Test: 150.degree. C. (oil) / liquid nitrogen, 2 minutes, respectively (one cycle) Evaluation: The presence of cracks in 20 packages was observed by microscopic observation. Soldering resistance IC: flat package, 19 .times. 14 .times. 2.7 (mm), 54 pins, alloy 42 lead frame, chip 6 .times. 6 .times. 0.4 (mm) (cracking of IC packages) Molding: 180.degree. C., 70 kg/cm.sup.2, 90 sec + 180.degree. C., 5 hours Test: After the IC packages were humidified under the conditions of 85.degree. C., 85% RH, a VPS ** was carried out at 215.degree. C. for 90 seconds.

Evaluation: The presence of cracks in 20 packages was observed by microscopic observation. Moisture resistance IC: flat package, 19 .times. 14 .times. 2.7 (mm), 54 pins, alloy 42 lead frame, chip 6 .times. 6 .times. 0.4 (mm) (corrosion of aluminum Chip: the sample chips were produced by forming an oxidated layer of 1 .mu.m thick on pattern in IC chips) silicon substrates and providing on the oxidated layer an aluminum pattern of 10 .mu.m in line width, 1 .mu.m thick. Test: humidifying at 85.degree. C., 85% RH, 72 hours, VPS treatment at 215.degree. C. for 90 seconds, and exposure to 2 atm PCT for a predetermined time, in this order. Evaluation: Electric failure due to corrosion of aluminum pattern was checked.

*

7261 (silver) produced by MarkemAsiatic Co., Inc. ** Vapor Phase Soldering

DOCUMENT-IDENTIFIER: US 5238730 A

TITLE: Electrical laminate with dibasic acid-modified epoxy (meth)acrylate

----- KWIC -----

ASZZ:

Hitachi Chemical Company, Ltd.

BSPR:

In Japanese Patent Application Publication No. 60-17340 disclosed is a method

wherein a resin obtained by reacting a halogenized bisphenol A diglycidyl ether with a dimer acid is used as the flame retardant for thermosetting resins, and

in Japanese Patent Application Publication open No. 60-45061 disclosed is a method of using a resin varnish consisting of a

dicyclopentadiene polyester resin, an acrylic ester of diglycidyl ether or glycidyl ester through a dibasic

acid of 4 to 36 carbon atoms, and an organic peroxide.

However, these

conventional methods failed in providing laminates satisfying all requirements

concurrently, that is, good flame resistance, improvement of the punching

quality at low temperature, moisture resistance, chemical resistance, and

excellent electrical properties.

DEPR:

Also, the other flame retardants may be added to these resins for impregnating base materials, at need. Typical examples of such flame retardants include

halogen-containing flame retardants such as hexabromocyclododecane,

hexabromobenzene, polybrominated biphenyl ether, heptabromotoluene,

2,4,6-tribromophenol methacrylate, 2,4,6-tribromophenol glycidyl ether,

brominated epoxy resins; and phosphoric esters such as triphenyl phosphate,

tricresyl phosphate, and trimethyl phosphate. The particularly preferred flame retardants are those which can be polymerized with the thermosetting resin compositions of the present invention.

DEPR:

A mixture of 100 parts of tetrabromobisphenol A glycidyl ether (epoxy equivalent: 395 to 410), 35.7 parts of dimer acid, 1.3 parts of benzylidimethylamine, 62 parts of styrene, and 0.05 parts of hydroquinone was reacted at 90.degree. to 100.degree. C. until the acid value dropped not more than 6, and reaction was then continued by adding 9 parts of methacrylic acid, to obtain a dimer acid modified epoxy methacrylate resin having an acid value of 2.3 (resin (7)).

DETL:

TABLE 1

Comparative Example 1	Comparative Example 2	Example 3
Example 4	Example 5	
Example 1	Example	
2		
<u>Water absorption</u> (%)	0.45 0.46 0.48 0.45 0.41 0.41 0.49	
E-24/50 + D-24/23		
Insulation resistance (.OMEGA.)	1.2 .times. 10.sup.10 1.1 .times. 10.sup.10	
5.0 .times. 10.sup.9 5.5 .times. 10.sup.8 6.1 .times. 10.sup.8 2.0 .times. 10.sup.11 3.2 .times. 10.sup.8 (D-2/100) Soldering heat		
resistance 60 57		
62 50 57 90 40 260.degree. C. (second) Flame resistance		
V-0 V-0 V-0 V-1 V-1		
V-0 HB Dielectric constant A (1 MHz) D-48/50	3.9 3.8 3.9 4.2 4.0 3.7 4.4	
4.6 4.6 4.5 4.8 4.6 4.3 5.0 Dielectric dissipation A		
0.0240 0.0242 0.241		
0.0310 0.0300 0.0260 0.0340 factor (1 MHz) D-48/50 0.0280		
0.0288 0.283		
0.0450 0.0420 0.0289 0.0450 Punching quality 20.degree. C. .DELTA. .DELTA.		
.DELTA. .circleincircle..about..DELTA. .DELTA. X		

.DELTA..about.X 40.degree.
C. .circleincircle. .circleincircle.
.circleincircle..about..DELTA.
.circleincircle. .circleincircle. .DELTA..about.X
.circleincircle..abo
ut..DELTA. 60.degree. C. .circleincircle.
.circleincircle. .circleincircle.
.circleincircle. .circleincircle. .DELTA.
.circleincircle. 80.degree. C.
.circleincircle. .circleincircle. .circleincircle.
.circleincircle..about..DELTA.
.circleincircle..about..DELTA.
.circleincircle..about..DEL TA. .circleincircle.

Test

methods Flame resistance: UL268 & 492 Punching quality:
ASTM D61744 the
others: JIS C 6481 D; dipping E; drying A; normal
condition 24/50; measurement
after standing at 50.degree. C. for 24 hours